A Systematic Study of the Kaon to Pion Multiplicity Ratios in Heavy-Ion Collisions [1]

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We report a systematic study of the kaon to pion multiplicity ratios (K^+/π^+ and K^-/π^-) in heavy-ion collisions from AGS to RHIC energy using the Relativistic Quantum Molecular Dynamics model (RQMD). For simplicity, we only consider the equal and large mass nucleus-nucleus collisions. The goal is to provide an understanding of the underlying mechanisms for K/π enhancement by comparing model results with available experimental data at various energies, and present predictions of the K/π ratios at RHIC energy.

The model can well reproduce the kaon and pion multiplicity data in p+p interactions. This justifies our approach to use RQMD to study heavy-ion collisions.

The RQMD-calculated ratios in heavy-ion collisions are higher than those in p+p interactions at the same energy, and increase from peripheral to central collisions. By comparing the results to those calculated by RQMD with particle rescattering (meson-induced interactions) turned off, we conclude that the K/π enhancement in central collisions with respect to peripheral collisions and p+p interactions is mainly due to meson-induced interactions, especially at the low AGS energy. We further conclude that rope formation does not change the K/π ratios significantly once particle rescattering is considered.

It is found that the K/π enhancement in central heavy-ion collisions over p+p interactions is larger at AGS than SPS energy, and decreases smoothly with bombarding energy. This behavior is consistent with the combination of the threshold effect of kaon production in p+p interactions and the dropping baryon density in heavy-ion collisions with increasing bombarding energy.

The RQMD model reasonably describes the available K^+/π^+ and K^-/π^- data in heavy-ion collisions. The observed K/π enhancement at the AGS and SPS can be understood in a hadronic model with string degrees of freedom.

The RQMD K/π results agree with experimental data better at midrapidity in the most central collisions. This is not surprising since it is the case where equilibrium is most likely to be reached. There the details of the description in any model is less relevant.

The total multiplicity ratios at RHIC energy are predicted by RQMD to be $K^+/\pi^+ = 0.19$ and $K^-/\pi^- = 0.15$. The midrapidity ratios at RHIC energy are predicted by RQMD to be $K^+/\pi^+ = 0.19$ and $K^-/\pi^- = 0.17$.

References

[1] F. Wang, H. Liu, H. Sorge, N. Xu, and J. Yang, nucl-th/9909001 [Report: LBNL-44128].